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TECHNICAL MEMORANDUM

title: Battery #019 Test Report (Test Series #5)

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Results - Test Series #5

A fifth series of battery 019 tests were conducted from 1 May to 14 May 1976. A total of 19,927.3 AH had been discharged from the battery at the beginning of the test series. During the ten cycles conducted, an additional 2983.5 AH were discharged for a total of 22,910.8 AH at the end of the fifth test series.

During the first five cycles of the test series the ambient pressure during discharge was varied from one cycle to the next. The discharge pressure was 3000 psig for the first cycle and 2,000 psig, 1,000 psig, 100 psig and 0 psig on the succeeding cycles. The purpose of this procedure was to determine the effects of discharge pressure upon charge acceptance (K_1) and charge efficiency (K_2). All the charges during these cycles were conducted at the 60/20 rate at 0 psig ambient pressure. The ambient temperature during the entire test series was about 18°C. All of the discharges throughout the test series were at 105 amperes. Results of test series #5 are shown in Table I and Figure 1. In addition values of K_1 and K_2 throughout the test series are shown in Table I and Figure 2.

Although the value of the charge efficiency factor, K_2, for cycle #1 was slightly lower than for the other cycles K_2 basically remained steady during the discharges at various pressures. There was no indication that discharge pressure had any effect upon K_2.

The charge acceptance factor declined with each succeeding cycle during the first five cycles as has been the case in previous test series. There was no significant change in this pattern for the first five cycles with discharges conducted at various pressures.

For the sixth and following charges the charge rate was reduced to 45/15 in order to increase the capacity slightly and also to provide another comparison between charge acceptance at the 60/20 rate and the 45/15 rate. An increase of 3.4% in K_1 was noted when the rate was reduced. This compares to a 3% increase after a similar reduction during test series #4. A further slight increase, 0.5%, was noted for the seventh cycle at the 45/15 ampere rate.

The charges during cycles #8, #9 and #10 were also conducted at 45/15 rate but at an ambient pressure of 250 psig. The purpose was to identify the effects of ambient pressure during charging upon K_1 and K_2.

Examination of Figure 2 shows no noticeable change in K_2 during cycles #8 - 10 when the charges were conducted at pressure. However, a definite drop (4.8%) in K_1 occurred at the eighth cycle.

K_1 value continued to drop for the ninth and tenth cycles but at a rate more consistent with past experience. Considering only this drop in K_1 at the eighth cycle it appeared that charging at pressure caused a reduction in charge acceptance. In order to check this result the eleventh charge was

conducted with all conditions the same as charges #8 through #10 except the pressure during charge was returned to 0 psig. An increase in K_1 similar in magnitude to the drop during cycle #8 would have supported the hypothesis that charging under pressure reduces K_1. However, the value for K_1 during the eleventh cycle dropped 1.6% continuing the trend of cycles #9 and #10. This result did not support the hypothesis and thus the effect of charging at pressure upon K_1 is still unclear.

Conclusions

1. Charge efficiency is independent of the pressure during discharge.
2. Charge acceptance is independent of the pressure during discharge.
3. Reducing the charging rates from 60/20 to 45/15 can increase charge acceptance about 3%.
4. Charge efficiency is independent of the pressure during charge.
5. Any dependence of charge acceptance upon pressurre during charge is as yet unsure.

Plans

Test series #6 will begin on 7 June 1976. The purpose of the test series will be to provide further information about the effect of several of the independent variables upon K_1, K_2 and K_3. During the past five test series some of the independent variables have been identified as having a significant impact upon K_1, K_2 of K_3 (e.g., charge rate cycles since maintenance charge). Others have been eliminated from further study due to a lack of dependence of K_1, K_2 and K_3 upon them (e.g., discharge pressure). However, some of the independent variables do not fall into either category and further data is required to establish their relationship with K_1, K_2 and K_3. The variables in this category which will be studied further is test series #6 are charge temperature, discharge rate and charge pressure. In addition the prototype power and instrumentation battery box connector will be installed on battery 019 and utilized during the test series.

DSRV BATTERY 019

TEST DATA

TABLE I

Month: May 1976
Test #: 5
Last Test Discharge: 416

Cycle Number	CHARGE Date	Rate (Amps)	A-H	Press (PSIG)	Temp (°F)	DISCHARGE Date	Rate (Amps)	A-H	Press. (psig)	Temp (°F)	% Acceptance	% Efficiency	Remarks
1	5/1	60/20	336/353	0	70°	5/3	105	340.3	3000	60°F	84.9	96.4	charged in Air
2	5/3	60/20	308/326	0	60°	5/4	105	321.6	2000	60°F	78.4	98.7	
3	5/4	60/20	282/305	0	60°	5/5	105	302.1	1000	60°	73.3	99.0	
4	5/5	60/20	283/299	0	60	5/6	105	296.4	100	60°	71.9	99.1	
5	5/6	60/20	277/293	0	60	5/7	105	290.0	0	60	70.4	99.0	
6	5/7	45/15	290/307	0	60	5/10	105	302.8	3000	60	73.8	98.6	
7	5/10	45/15	293/309	0	60	5/11	105	308.4	1500	60	74.3	99.8	charge interrupted for Ic repair
8	5/11	45/15	268/289	250	60	5/12	105	288.9	1500	60	69.5	100.0	
9	5/12	45/15	256/272	250	60	5/13	105	269.3	1500	60	65.4	99.0	
10	5/13	45/15	246/266	250	60	5/14	105	263.7	1500	60	63.9	99.1	
	5/14	45/15	247/254	0	60						62.3		

FIFTH TEST SERIES OF 019 BATTERY 10 CYCLES (1MAY THRU 14MAY76)

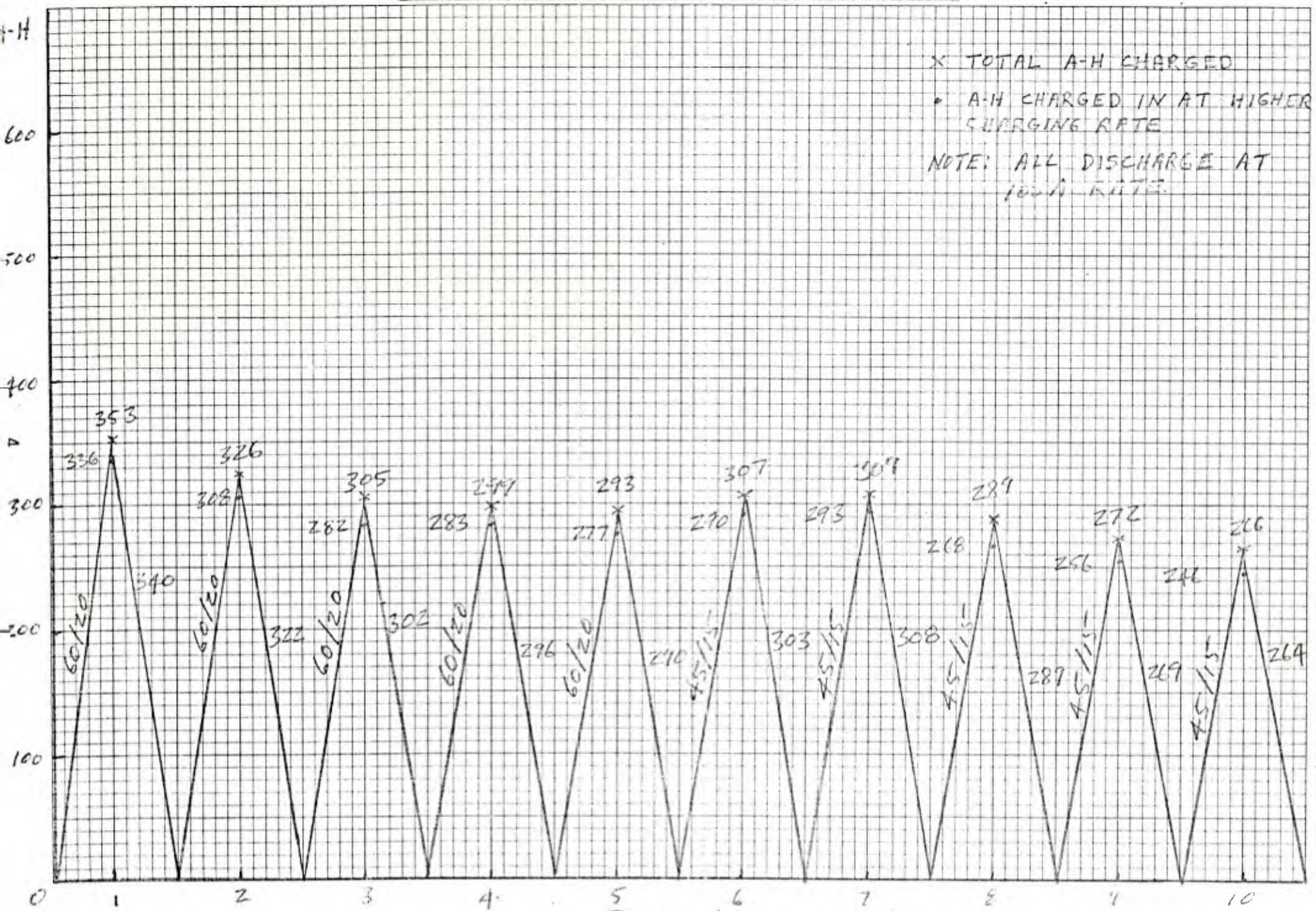

Figure 1.

Cycles

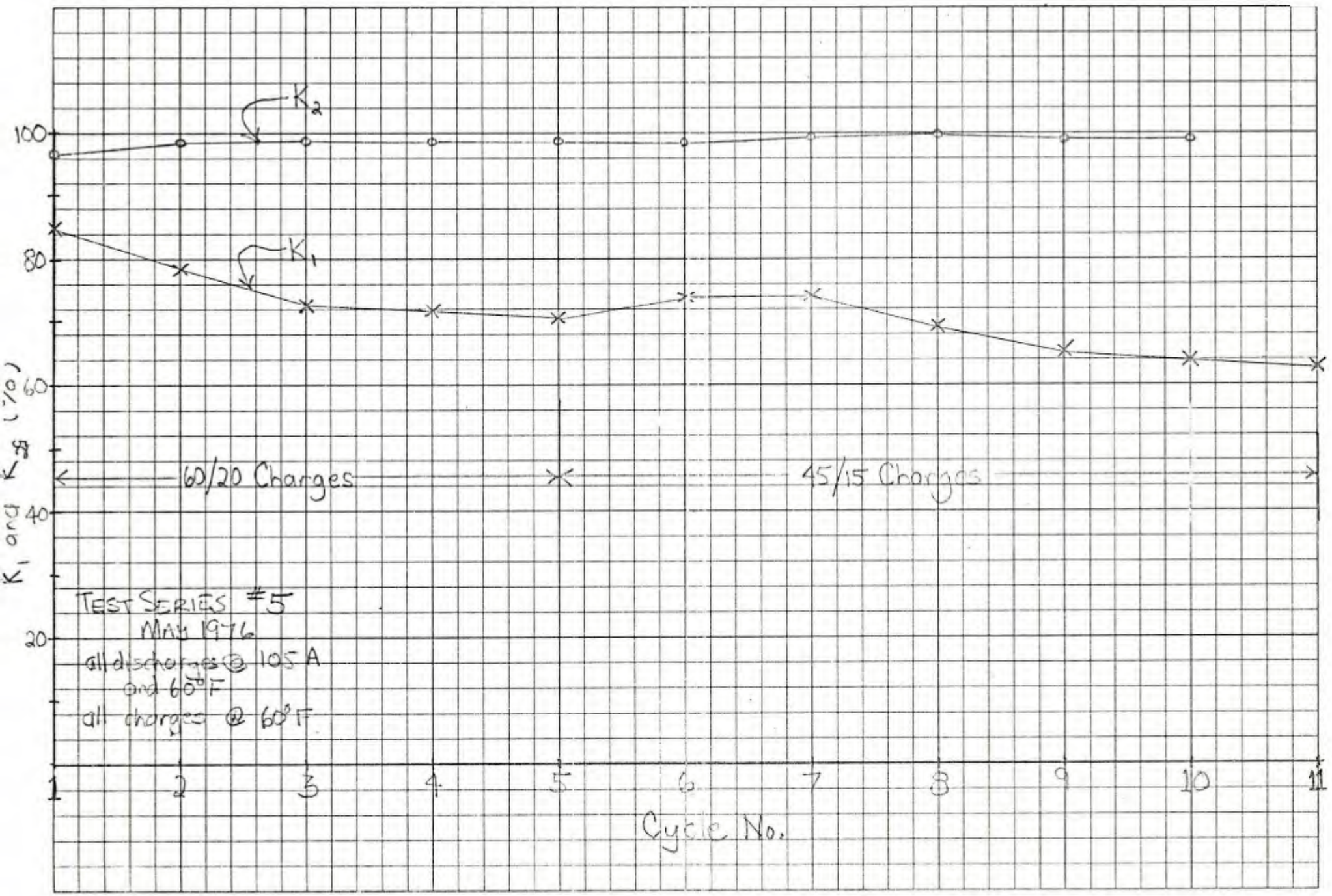

Figure 2